

# PRV

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**A filter****BACKGROUND OF THE INVENTION AND PRIOR ART**

10 The present invention refers to a filter for a cartridge containing a particulate material, wherein the filter is intended to permit passage of a liquid through the filter and thus the cartridge, but to prevent passage of the particulate material, wherein the filter permits the liquid to pass through the filter in a filter direction. The present

15 invention also refers to a cartridge arranged to contain a particulate material, wherein the cartridge includes: an inner space for housing the particulate material; an inlet arranged to permit the introduction of a liquid into the inner space; an outlet arranged to permit discharge of liquid from the inner space; and at least a first filter

20 arranged at the outlet and to permit passage of the liquid through the filter, but to prevent passage of the particulate material through the filter, wherein the filter permits the liquid to pass through the filter in a filter direction. Moreover, the present invention refer to a use of a filter in a cartridge containing a particulate material,

25 wherein the cartridge includes: an inner space for housing the particulate material; an inlet arranged to permit the introduction of a liquid into the inner space; an outlet arranged to permit discharge of liquid from the inner space; and at least one filter arranged at the outlet and to permit passage of the liquid through the filter but to

30 prevent passage of the particulate material through the filter, wherein the filter permits the liquid to pass through the filter in a filter direction. The present invention also refers to a system for preparing a liquid solution for a medical procedure.

35 In a dialysis equipment, it is known to use such a cartridge for the supply of different substances to the dialysis liquid, see EP-B-278 100. The particulate material contained in the cartridge may include

various substances to be supplied to the dialysis liquid, such as sodium bicarbonate, sodium chloride and other salts. In use, the dialysis liquid is flowing through the cartridge, wherein the particulate substance is successively dissolved and thus added to the dialysis liquid. Consequently, the general purpose of the filter is to permit the passage of the dialysis liquid together with a dissolved quantity of the substance, but to prevent the passage of any particles of the particulate material. If such particles of the substance are contained in the dialysis liquid, sensible parts of the dialysis equipment, such as pumps, may be damaged.

The filter used today in such a cartridge is made of a fibre material, such as polypropylene, in the form of a woven filter net. Such a filter is flexible, and thus not self-supporting. The filter, therefore, has to be supported by a supporting component, for instance in the form of a support plate. The filter is mounted to the support plate in a position adjacent to the support plate, wherein the filter and support plate form a common unit that is mountable in the cartridge. The manufacture of such a filter unit is relatively complicated and expensive, since the manufacture includes the separate steps of manufacturing the woven filter, manufacturing the support plate and joining the filter and the plate to each other. Moreover, it is difficult to obtain exactly the desired permeability for such a filter. In particular, the permeability frequently is too high, which involves a risk for formation of channels in the particulate material contained in the cartridge.

Another problem which may occur with the cartridges used today is that the particulate material may escape from the cartridge through the inlet and the outlet before the cartridge is actually used, especially via the inlet during the initial priming operation. In order to reduce this risk of escape, a felt pad or any other similar porous member is incorporated in the inlet and the outlet. In particular, during priming from below, via the outlet, the felt pad at the inlet is important. The porous felt pad is normally manufactured in another material than the rest of the cartridge, which is disadvantageous from a recycling point of view.

## SUMMARY OF THE INVENTION

5 The object of the present invention is to provide an improved filter for a cartridge containing a particulate material. In particular, it is aimed at a filter, which is inexpensive to manufacture and which demonstrates a uniform and reliable permeability.

10 This object is achieved by the filter initially defined, which is characterised in that the filter includes at least one slit-shaped opening, which has a first extension and second extension being substantially perpendicular to the filter direction and to the first extension, wherein the second extension is significantly shorter than the first extension.

15 By such a filter, a uniform flow area of the slit-shaped opening or slit-shaped openings is ensured. Any particles of the particulate material having a minimum size larger than the second extension will be efficiently prevented from passing the filter, and thus from  
20 causing any damages to components arranged downstream the filter. Such a filter also permits the achievement of a desired pressure drop over the filter. With an appropriate pressure drop a channelling in the particulate material may be avoided. It should also be pointed out that such a filter may be manufactured in an  
25 inexpensive manner by means of an injection moulding process.

30 According to an embodiment of the invention, the second extension is also significantly shorter than the length of the slit-shaped opening in the filter direction. This feature permits a certain thickness of the filter ensuring a sufficient strength of the filter. Consequently, the filter is self-supporting and does not need any support plate to be provided adjacent to the filter, which also contributes to reducing the manufacturing costs.

35 According to a further embodiment of the invention, the second extension is equal to or less than 0,1 mm, preferably equal to or less than 0,08 mm. Moreover, the second extension may be equal

to or more than 0,02 mm, preferably equal to or more than 0,04 mm. According to an advantageous embodiment, the second extension is approximately 0,06 mm.

- 5 According to a further embodiment of the invention, the filter is made of a polymer material, including one of polypropylene and polycarbonate.

- 10 According to a further embodiment of the invention, the filter includes a disc, wherein the slit-shaped opening extends through the disc. Advantageously, the filter includes a plurality of such slit-shaped openings, which extend through the disc. Such disc may be easily moulded in one single piece. The first extension of each slit-shaped opening may extend in a radial directed towards a centre point of the disc, providing a plurality of slit-shaped openings in a star-like configuration.
- 15

- 20 According to a further embodiment of the invention, the slit-shaped opening has an upstream end and a downstream end with respect to the filter direction, wherein the second extension of the slit-shaped opening increases in the filter direction from a minimum value at the upstream end of the slit-shaped opening to a maximum value at the downstream end of the opening. Such a shape of the slit-shape opening or openings is advantageous from a manufacturing point of view.
- 25

- 30 According to another embodiment of the invention, the filter includes a first disc and a second disc, which are arranged in parallel with each other and separated from each other by an interspace that form the split-shaped opening. Advantageously, the interspace is formed by distance members arranged in the interspace between the discs, each of said distance members having a predetermined height corresponding to the second extension. Furthermore, each of said distance members may include a projection extending from one of the first disc and the second disc. In order to provide said liquid passage through the filter, the first disc may be provided with at least one aperture
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forming an inlet passage to the interspace, and the second disc with at least one aperture forming an outlet passage from the interspace.

According to a further embodiment of the invention, the disc is  
5 made through an injection moulding process.

The object is also achieved by the cartridge initially defined, which is characterised in that the filter includes at least one slit-shaped opening, which has a first extension and a second extension being  
10 substantially perpendicular to the filter direction and to the first extension, wherein the second extension is significantly shorter than the first extension.

Advantageous embodiments of the cartridge are defined in the  
15 dependent claims 20 to 37.

Furthermore, the object is achieved by the use of such a filter in such a cartridge, wherein the use includes the step of supplying said liquid to the cartridge in such a way that the liquid passes  
20 through particulate material and thereby dissolves at least a part of the particulate material to form a liquid solution. The liquid may be a dialysis liquid. The particulate material may include bicarbonate and/or sodium chloride.

25 Furthermore, the object is achieved by the system initially defined, which is characterised in that the filter includes at least one slit-shaped opening, which has a first extension substantially perpendicular to the filter direction and a second extension substantially perpendicular to the filter direction and to the first  
30 extension, wherein the second extension is significantly shorter than the first extension. Advantageous embodiments are defined in claims 42 to 44

**BRIEF DESCRIPTION OF THE DRAWINGS**

The present invention is now to be described more closely by the following description of various embodiments and with reference to  
5 the drawings attached.

- Fig 1 discloses schematically a system for preparing a liquid solution for a medical procedure.
- 10 Fig 2 discloses schematically a cartridge according the present invention.
- Fig 3 discloses schematically a plan view of a first embodiment of a filter to be arranged in the cartridge of Fig 2.
- 15 Fig 4 discloses schematically a sectional view of the filter along the line IV-IV in Fig 3.
- Fig 5 discloses schematically a sectional view of the filter along the line V-V in Fig 3.
- 20 Fig 6 discloses schematically a plan view of a second embodiment of a filter to be arranged in the cartridge of Fig 2.
- Fig 7 discloses schematically a sectional view of the filter along the line VII-VII in Fig 6.

25 **DETAILED DESCRIPTION OF VARIOUS EMBODIMENTS OF THE INVENTION**

Fig 1 discloses schematically a system for preparing a liquid solution for a medical procedure. In particular, the system is designed for preparing a dialysis liquid solution for the performance of a hemodialysis treatment. The system may also be used for hemodiafiltration and hemofiltration. The system disclosed in Fig 1 may thus form a part of a dialysis equipment.

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The system includes a source 1 containing a liquid, and in particular a dialysis liquid. The source 1 may be supplied with the liquid via an inlet conduit 2. A first liquid conduit 3 has a first end 4 communicating with the source 1 to withdraw the dialysis liquid into

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the first liquid conduit 3. The first liquid conduit 3 also has a second end 5 for delivering a dialysis liquid solution to a receiver (not disclosed) such as a dialysis equipment. A second liquid conduit 6 has a first end 7 communicating with the source 1 and a second end 8 communicating with the inlet of a cartridge 9 for the introduction of the liquid from the source 1 into an inner space 10 of the cartridge 9 to produce a concentrate liquid solution. A third liquid conduit 11 has a first end 12 communicating with the outlet of the cartridge 9 and a second end 12 communicating with the first liquid conduit 3 at a mixing point 13 intermediate said first end 4 and said second end 5.

The third liquid conduit 11 is thus arranged to withdraw said concentrate liquid solution from the cartridge 9 into the first liquid conduit 3 to be mixed with the liquid conducted through the first liquid conduit 3 from the source 1 in order to produce a liquid solution for delivery to said receiver. The concentrate liquid solution is transported through the third liquid conduit 11 by means of a pump 15. The liquid is transported from the source 1 to said receiver through the first liquid conduit 3 by means of a pump 16. A control loop 17 including a valve 19 may be arranged to control the quantity of concentrate liquid solution to be delivered to the liquid of the first liquid conduit 3.

25 The cartridge 9 is explained below with reference to Fig 2. In the embodiment disclosed, it is referred to the production of a dialysis liquid solution to which sodium bicarbonate has been added. It is to be noted that also other substances than sodium bicarbonate can be added in a similar manner to the dialysis liquid, for instance sodium chloride and other salts. It is also to be noted, that the system, the cartridge and the components included therein can be used also for producing other liquid solutions than a dialysis liquid.

30 The cartridge 9 is arranged to contain a particulate material 20 in the inner space 10. In the embodiment disclosed the particulate material 20 is a sodium bicarbonate powder. The cartridge 9 has an inlet 21 which is arranged to permit the introduction of a liquid into



the inner space 10. In the embodiment disclosed the inlet 21 is connected to and communicates with the second liquid conduit 6. The cartridge 9 also has an outlet 22 arranged to permit the discharge of liquid from the inner space 10. In the embodiment disclosed, the outlet 22 is connected to and communicates with the third liquid conduit 11 for discharging the concentrate liquid solution.

A first filter 23 is arranged at the outlet 22 to permit passage of said liquid through the filter 23, but to prevent the passage of the particulate material 20 through the filter 23. The filter 23 defines a filter direction x, and thus permits the liquid to pass through the filter 23 in the filter direction x. The cartridge 9 also includes a second filter 24 arranged at the inlet 21 to permit passage of the liquid through the filter 24, but to prevent passage of the particulate material 20 through the filter 24. Also the second filter 24 defines a filter direction x and permits the liquid to pass through the filter 24 in the filter direction x. It is to be noted that according to this invention such a filter 23 is provided at the outlet 22. The provision of the second filter 24 at the inlet 21 is preferable, but not mandatory.

The filters 23 and 24 rest on a respective support member in the form of a shoulder 25, 26 extending around the inner periphery of the inner space 10 in the proximity of the inlet 21 and the outlet 22, respectively. Furthermore, a respective smaller shoulder 27 and 28 extends around the inner periphery of the inner space 10 above the filter 24 and 23, respectively, in order to permit the locking of the filters 23, 24 at their respective position on the shoulders 25, 26.

Preferably, the filters 23 and 24 are identical to each other. Two different embodiments of the filters 23, 24 are explained below with reference to Figs 3-7.

Figs 3-5 disclose a first embodiment of the filter 23, 24. The filter 23, 24 has the shape of a substantially circular and substantially plane disc 29 having a main extension plane. It is to be noted, that

the thickness of the disc 29 is exaggerated in the figures in order to simplify the explanation of the filter construction. The filter 23, 24 includes a number of slit-shaped openings 30. Each such opening 30 has a first extension, indicated by the line 31 in Fig 3 for one of the openings 30. Each opening 30 also has a second extension, indicated by the line 32 in Figs 3 and 5. The second extension 32 is substantially perpendicular to the first extension 31. Both the second extension 32 and the first extension 31 are substantially perpendicular to the flow direction x.

In accordance with the present invention, the second extension 32 is significantly shorter than the first extension 31. Moreover, the second extension 32 is significantly shorter than the length 33 of the slit-shaped opening 30 in the filter direction x. For instance, the length 33 may be 10 – 100 times the second extension 32. In particular, the second extension 32 is equal to or less than 0,1 mm, preferably equal to or less than 0,08 mm. Moreover, the second extension 32 is equal to or more than 0,02 mm, preferably equal to or more than 0,04 mm. According to a preferred embodiment, the second extension 32 is approximately 0,06 mm.

The slit-shaped openings 30, which extend through the disc 29, are, in the embodiment disclosed, provided to extend in a radial direction with regard to the first extension 31 and a centre point of the disc 29. However, the slit-shaped openings 30 may also be arranged to extend in other directions, for instance the disc 29 may include a plurality of slit-shaped openings 30 extending in parallel to each other. The disc 29 is made in a polymer material, for instance polycarbonate or polypropylene. The disc 29 may be manufactured through an injection moulding process by injecting said polymer material into a mould cavity having the shape of the disc 29. Each slit-shaped opening 30 has an upstream end and a downstream end with respect to the filter direction x. As appears from Fig 5, the second extension 32 of the slit-shaped opening 32 increases in the filter direction x from a minimum value at the upstream end of the slit-shaped opening 30 to a maximum value at the downstream end

of the slit-shaped opening 30. Such a shape of the slit-shaped opening facilitates the injection moulding of the disc 29.

5 The filter 23, 24 includes a circumferential flexible edge portion 36 formed as a part of the disc 29. The edge portion 36 is flexible in an radial inward direction and formed by the provision of a circumferential groove 37 extending radially inside the edge portion 36. Consequently, the flexible edge portion 36 may be bent radially inwardly when the filter 23, 24 is introduced at its position on the  
10 shoulder 25, 26 in order to pass the shoulder 27, 28. After having passed the shoulder 27, 28, the flexible edge portion 36 may flex back to the outer position disclosed in Fig 4.

Figs 6 and 7 discloses a second embodiment of the filter 23, 24.  
15 The filter 23, 24 according to this embodiment includes two discs, a first disc 41 and a second disc 42. The discs 41 and 42 are both substantially circular and substantially plane and have a respective main extension plane. The discs 41, 42 are arranged substantially in parallel with each other and separated from each other by means  
20 of a number of distance members 43. The distance members 43 form a part of and extend from one of the discs 41, 42. In the embodiment disclosed, the distance members are formed on the second disc 42. Thanks to the distance members 43, an interspace 44 is formed between the discs 41 and 42. The distance members  
25 43 have a predetermined height defining the thickness of the interspace 44.

In the second embodiment, the filter direction x extends, in contrast to the first embodiment, in parallel with the discs 41 and 42. The  
30 slit-shape opening 30 is formed by the interspace 44. Consequently, the second extension 32 correspond to the height of each distance member 43.

The first disc 41 includes a number of apertures 46 extending through the first disc 41 and forming outlet passages from the interspace 44. The second disc 44 also includes a number of  
35 apertures 47 forming an inlet passage to the interspace 44. The

apertures 46 of the first disc 41 are arranged in such a way that they are not positioned opposite any one of the apertures 47 of the second disc 42. More precisely, the apertures 47 are arranged along a radially inner ring and a radially outer ring whereas the apertures 46 are arranged along a ring in an intermediate position between said inner ring and said outer ring. It is to be noted, that the apertures 46, 47 also may be arranged in other positions than the ones disclosed.

The liquid passing through the filter 23, 24 will thus enter the interspace 44 via one of the apertures 47 and flow through the interspace 44 in the filter direction x to one of the apertures 46 of the first disc 41 to be discharged from the filter 23, 24. Since the liquid may flow from an aperture at said outer ring or from an aperture along said inner ring towards an aperture along said intermediate ring, the flow direction in the second embodiment includes all directions in a plane being parallel with the main extension planes of the discs 41, 42. This is indicated by the double arrow x in Fig 7.

The distance members 43 are positioned between the apertures 47 along said inner ring and between the apertures 47 along the said outer ring. More precisely, a distance member 43 is provided between each pair of adjoining apertures along said inner and outer rings.

The first disc 41 also includes a central cavity 48 arranged to receive a central projection 49 of the second disc 42. By means of the cavity 48 and the projection 49 the second disc 42 may be securely positioned in the first disc 41.

The present invention is not limited to the embodiments disclosed but may be varied and modified within the scope of the following claims. In the embodiment disclosed in Figs 3 - 5, the first extension 31 is substantially straight. It is to be noted, however, that the first extension 31 as an alternative may be curved.

Claims

1. A filter (23, 24) for a cartridge (9) containing a particulate material (20), wherein the filter is intended to permit passage of a liquid through the filter and thus the cartridge, but to prevent passage of the particulate material, wherein the filter permits the liquid to pass through the filter in a filter direction (x), characterised in that the filter includes at least one slit-shaped opening (30), which has a first extension (31) and a second extension (32) being substantially perpendicular to the filter direction (x) and to the first extension (31), wherein the second extension is significantly shorter than the first extension.
2. A filter according to claim 1, characterised in that the second extension (32) is significantly shorter than the length (33) of the slit-shaped opening in the filter direction (x).
3. A filter according to any one of claims 1 and 2, characterised in that the second extension (32) is equal to or less than 0,1 mm.
4. A filter according to any one of claims 1 and 2, characterised in that the second extension (32) is equal to or less than 0,08 mm.
5. A filter according to any one of the preceding claims, characterised in that the second extension (32) is equal to or more than 0,02 mm.
6. A filter according to any one of the preceding claims, characterised in that the second extension (32) is equal to or more than 0,04 mm.
7. A filter according to any one of the preceding claims, characterised in that the second extension (32) is approximately 0,06 mm.

8. A filter according to any one of the preceding claims, characterised in that the filter (23, 24) is made of a polymer material, including one of polypropylene and polycarbonate.

5 9. A filter according to any one of the preceding claims, characterised in that the first extension (31) is substantially perpendicular to the filter direction (x).

10 10. A filter according to any one of the preceding claims, characterised in that the filter (23, 24) includes a disc (29), wherein the slit-shaped opening (30) extends through the disc.

15 11. A filter according to claim 10, characterised in that the filter (23, 24) includes a plurality of slit-shaped openings (30), which extend through the disc.

20 12. A filter according to claim 11, characterised in that the first extension of each slit-shaped opening (30) extends in a radial direction towards a centre point of the disc (29).

25 13. A filter according to any one of claims 10 to 12, characterised in that the slit-shaped opening (30) has an upstream end and a downstream end with respect to the filter direction (x), wherein the second extension (32) of the slit-shaped opening (32) increases in the filter direction (x) from a minimum value at the upstream end of the slit-shaped opening to a maximum value at the downstream end of the opening.

30 14. A filter according to any one of claims 1 to 9, characterised in that the filter (23, 24) includes a first disc (41) and a second disc (42), which are arranged substantially in parallel with each other and separated from each other by an interspace (44) that form the slit-shaped opening (30).

35 15. A filter according to claim 14, characterised in that the interspace (44) is formed by distance members (43) arranged in the interspace (44) between the discs (41, 42), each of said distance

members (43) having a predetermined height corresponding to the second extension (32).

5 16. A filter according to 15, characterised in that each of said distance members (43) includes a projection extending from one of the first disc (41) and the second disc (42).

10 17. A filter according to any one of claims 14 to 16, characterised in that the first disc (41) is provided with at least one aperture (46) forming an outlet passage to the interspace, and that the second disc (42) is provided with at least one aperture (47) forming an inlet passage from the interspace.

15 18. A filter according to any one of claims 10 to 17, characterised in that said disc (29, 41, 42) is made through an injection moulding process.

19. A cartridge arranged to contain a particulate material (20), wherein the cartridge includes:  
 20 an inner space (10) for housing the particulate material;  
 an inlet (21) arranged to permit the introduction of a liquid into the inner space (10);  
 an outlet (22) arranged to permit the discharge of liquid from the inner space (10); and  
 25 at least a first filter (23) arranged at the outlet (22) and to permit passage of the liquid through the filter, but to prevent passage of the particulate material (20) through the filter, wherein the filter permits the liquid to pass through the filter in a filter direction (x),  
characterised in that the filter (23) includes at least one slit-shaped  
 30 opening (30), which has a first extension (31) and a second extension (32) being substantially perpendicular to the filter direction (x) and to the first extension, wherein the second extension (32) is significantly shorter than the first extension (31).

35 20. A cartridge according to claim 19, wherein the cartridge includes a second filter (24) arranged at the inlet (21) and to permit passage of the liquid through the filter (24), but to prevent passage

- of the particulate material (20) through the filter (24), wherein the second filter permits the liquid to pass through the filter (24) in a filter direction (x), characterised in that the second filter includes at least one slit-shaped opening, which has a first extension (31) and
- 5 a second extension (32) being substantially perpendicular to the filter direction (x) and to the first extension (31), wherein the second extension (32) is significantly shorter than the first extension (31).
21. A cartridge according to any one of claims 19 and 20,
- 10 characterised in that the second extension (32) is significantly shorter than the length of the slit-shaped opening in the filter direction (x).
22. A cartridge according to any one of claims 19 to 21,
- 15 characterised in that the second extension (32) is equal to or less than 0,1 mm.
23. A cartridge according to any one of claims 19 to 21,
- 20 characterised in that the second extension (32) is equal to or less than 0,08 mm.
24. A cartridge according to any one of claims 19 to 23,
- 25 characterised in that the second extension (32) is equal to or more than 0,02 mm.
25. A cartridge according to any one of claims 19 to 24,
- characterised in that the second extension (32) is equal to or more than 0,04 mm.
- 30 26. A cartridge according to any one of claims 19 to 25,
- characterised in that the second extension (32) is approximately 0,06 mm.
- 35 27. A cartridge according to any one of claims 19 to 26,
- characterised in that the filter (23, 24) is made of a polymer material, including one of polypropylene and polycarbonate.



28. A filter according to any one of claims 19 to 27, characterised in that the first extension (31) is substantially perpendicular to the filter direction (x).

5 29. A cartridge according to any one of claims 19 to 28, characterised in that the filter (23, 24) includes a disc (29), wherein the slit-shaped opening (30) extends through the disc.

10 30. A cartridge according to claim 29, characterised in that the filter (23, 24) includes a plurality of slit-shaped openings (30), which extend through the disc (29).

15 31. A cartridge according to claim 30, characterised in that the first extension (31) of each slit-shaped opening (30) extends in a radial direction towards a centre point of the disc (29).

20 32. A cartridge according to any one of claims 29 to 31, characterised in that the slit-shaped opening (30) has an upstream end and a downstream end with respect to the filter direction, wherein the second extension (32) of the slit-shaped opening increases in the filter direction from a minimum value at the upstream end of the slit-shaped opening to a maximum value at the downstream end of the opening (30).

25 33. A cartridge according to any one of claims 19 to 30, characterised in that the filter (23, 24) includes a first disc (41) and a second disc (42), which are arranged in parallel with each and separated from each other by an interspace (44) that form the split-shaped opening (30).

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34. A cartridge according to claim 33, characterised in that the interspace (44) is formed by distance members (43) arranged in the interspace (44) between the discs (41, 42), each of said distance members (43) having a predetermined height corresponding to the  
35 second extension (32).

35. A cartridge according to 34, characterised in that each of said distance members (45) includes a projection extending from one of the first disc (41) and the second disc (42).

5 36. A cartridge according to any one of claims 33 to 35, characterised in that the first disc (41) is provided with at least one aperture (46) forming an outlet passage to the interspace (44), and that the second disc (42) is provided with at least one aperture (47) forming an inlet passage from the interspace (44).

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37. A cartridge according to any one of claims 29 to 36, characterised in that said disc (29, 41, 42) is made through an injection moulding process.

15 38. A use of a filter (23, 24) in a cartridge (9) containing a particulate material, wherein the cartridge includes:  
an inner space (10) for housing the particulate material (20);  
an inlet (21) arranged to permit the introduction of a liquid into the inner space (10);

20 an outlet (22) arranged to permit discharge of liquid from the inner space (10); and

at least one filter (23) arranged at the outlet (22) and to permit passage of the liquid through the filter, but to prevent passage of the particulate material through the filter, wherein the filter permits the liquid to pass through the filter in a filter direction (x), wherein the filter (23) includes at least one slit-shaped opening (30), which has a first extension (31) and a second extension (32) substantially perpendicular to the filter direction (x) and to the first extension (31), wherein the second extension (32) is significantly shorter than the first extension (31), the use including the step of supplying said liquid to the cartridge (9) in such a way that the liquid passes through the particulate material (20) and thereby dissolves at least a part of the particulate material (20) to form a liquid solution.

35 39. A use according to claim 38, wherein the liquid is a dialysis liquid.

40. A use according to any one of claims 38 and 39, wherein the particulate material includes bicarbonate and/or sodium chloride.

41. A system for preparing a liquid solution for a medical  
5 procedure, the system including:  
a cartridge containing a particulate material in an inner space  
thereof and including an inlet (21) and an outlet (22);  
a first liquid conduit (3) having a first end (4) communicating with a  
source (1) of liquid to withdraw the liquid into the first liquid conduit  
10 (3) and a second end;  
a second liquid conduit (6) having a first end (7) communicating  
with a source (1) of liquid and a second end (8) communicating with  
the inlet of the cartridge (9) for introducing the liquid into the inner  
space (10) to produce a concentrate liquid solution containing at  
15 least a part of the particulate material dissolved in the liquid;  
a third liquid conduit (11) communicating with the outlet of the  
cartridge and with a mixing point (13) in the first liquid conduit (3)  
intermediate said first and second ends (4, 5) for conducting said  
concentrate liquid solution from the cartridge (9) into said first liquid  
20 conduit to be mixed with the liquid being conducted through the first  
liquid conduit to thereby produce said liquid solution in the first  
liquid conduit for delivery to said second end of the first liquid  
conduit; and  
at least one filter (23) arranged at the outlet (22) and to permit  
25 passage of the liquid through the filter, but to prevent passage of  
the particulate material through the filter, wherein the filter (23)  
permits the liquid to pass through the filter in a filter direction (x),  
characterised in that the filter includes at least one slit-shaped  
opening (30), which has a first extension (31) and a second  
30 extension (32) being substantially perpendicular to the filter  
direction (x) and to the first extension (31), wherein the second  
extension (32) is significantly shorter than the first extension (31).

42. A system according to claim 41, characterised in that the filter  
35 includes the features of any one of claims 2 to 15.

43. A system according to any one of claims 41 and 42, wherein the liquid is a dialysis liquid.

5 44. A system according to any one of claims 41 to 43, wherein the particulate material includes bicarbonate and/or sodium chloride.

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**Abstract**

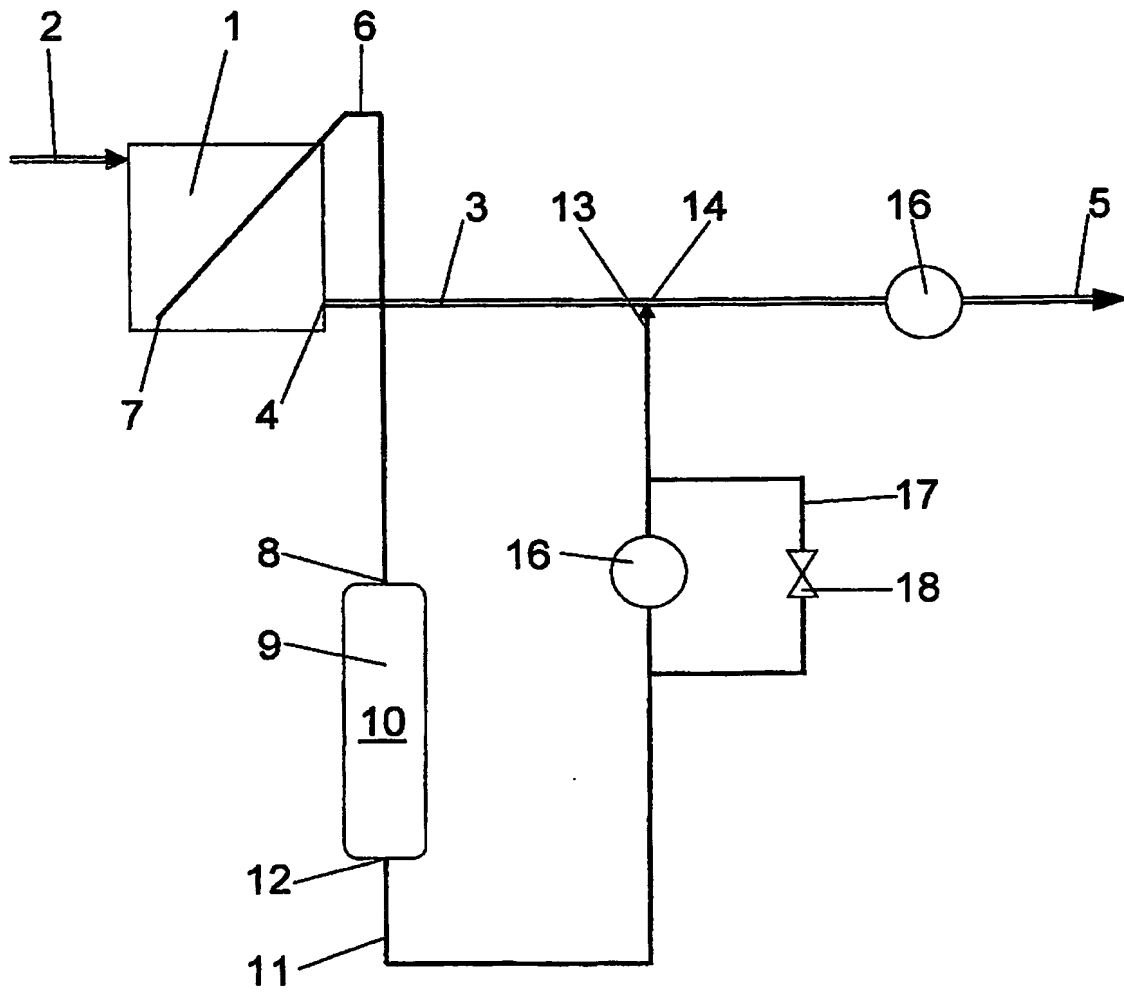
The invention refers to a filter (23, 24), a cartridge (9) containing a particulate material (20), a use of the filter and a system for  
5 preparing a liquid solution. The cartridge (9) includes an inner space (10) for housing the particulate material (20), an inlet (21) arranged to permit the introduction of a liquid into the inner space, and an outlet (22) arranged to permit discharge of liquid from the inner space. The filter (23) is arranged at the outlet (22) to permit  
10 passage of the liquid in a filter direction (x) through the filter but to prevent passage of the particulate material through the filter. The filter includes at least one slit-shaped opening, which has a first extension and a second extension being substantially perpendicular to the filter direction (x). The second extension is significantly  
15 shorter than the first extension.

(Fig 2)

20

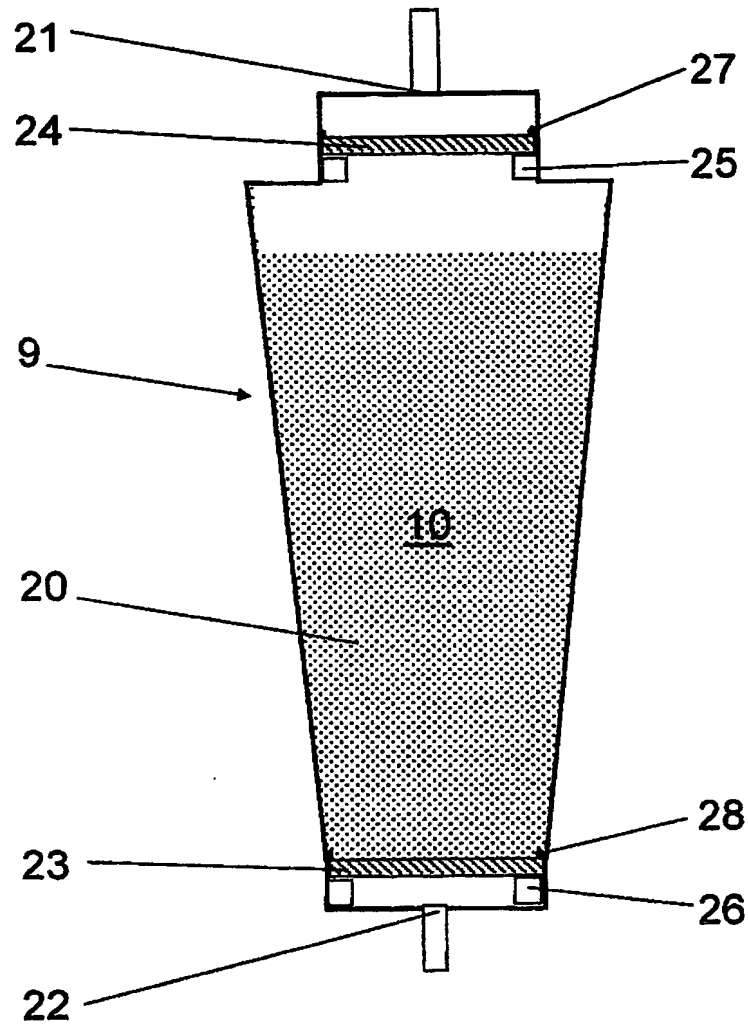
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Fig 1



2/4

Fig 2



3/4

Fig 3

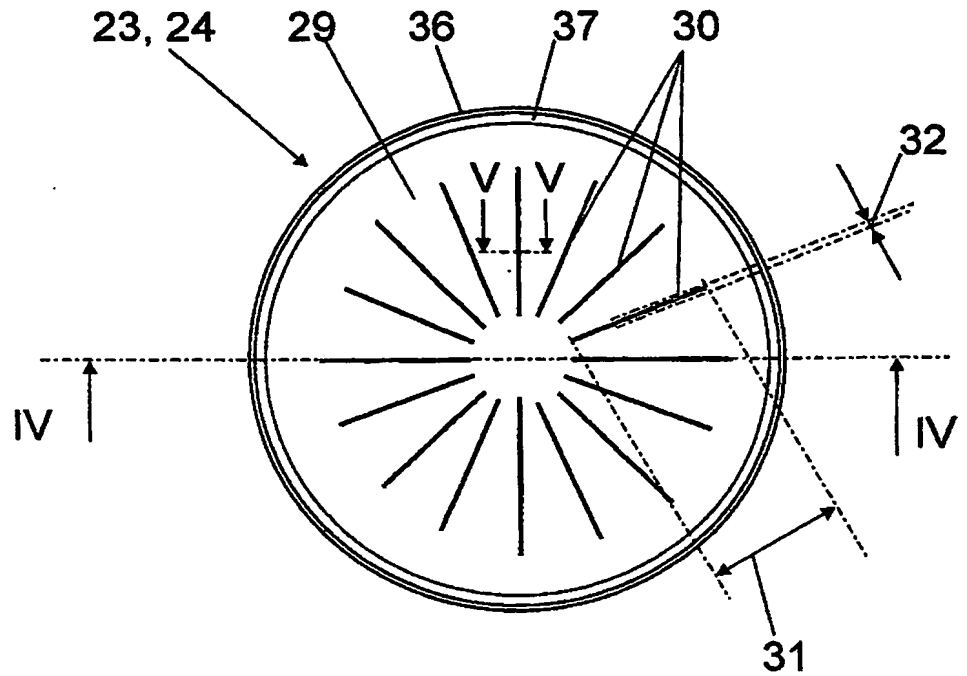


Fig 4

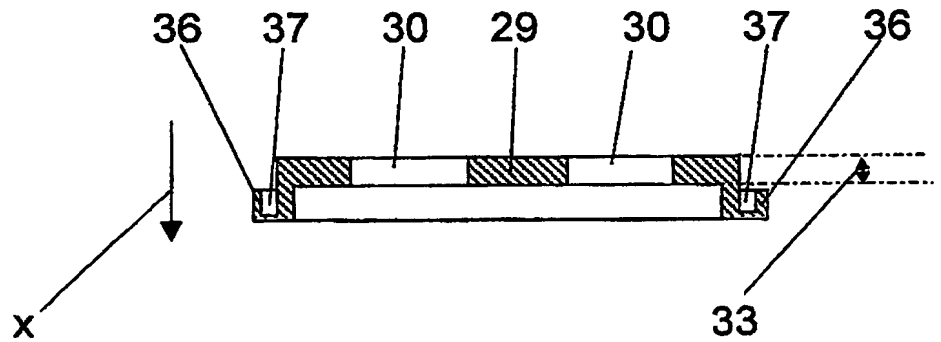
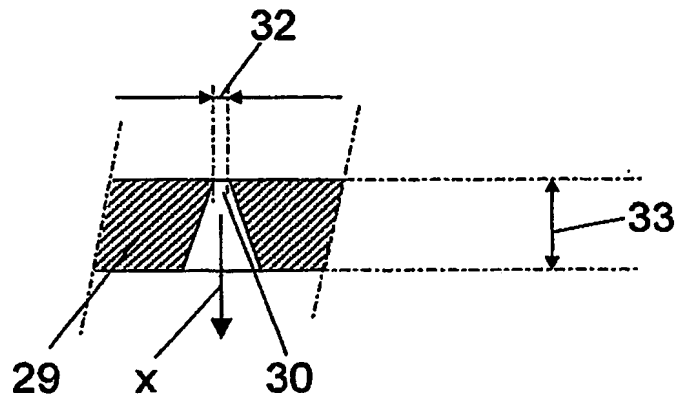
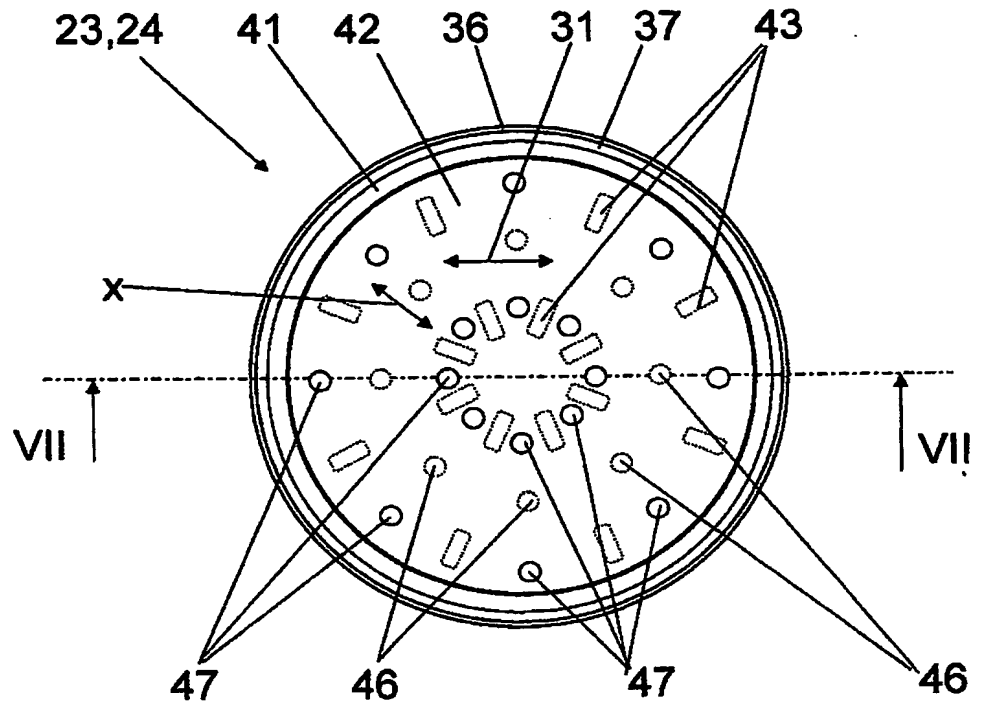


Fig 5





**Fig 6**



**Fig 7**

